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Considering alternative calculations of weight suppression

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ABSTRACT

Weight suppression (WS)—the difference between an individual's highest adult weight and current weight—relates to eating pathology and weight gain; however, there are several methodological issues associated with its calculation. The current study presents four alternative methods of calculating WS and tests whether these methods differentially relate to maladaptive outcomes. Alternative methods of calculation included: (1) change in BMI units; (2) BMI category change; (3) percent change in weight; and (4) two different uses of regression residuals. A sample of undergraduate students ($N = 631$) completed self-report measures of eating pathology, current and past weight, and teasing. Measures included the Eating Disorder Examination-Questionnaire and the Perceptions of Teasing Scale. Results indicated that components of WS, current weight and highest weight, were strongly related in the present sample. The traditional method of calculating WS was related to eating pathology, binge eating and teasing for both males and females. However, WS indices orthogonal to the highest weight did not correlate with eating pathology and teasing in both males and females; for females, WS indices orthogonal to current weight were also unrelated to eating pathology. Findings suggest that the link between WS and eating pathology is mitigated after accounting for an individual's highest weight. Future research should continue to assess the reliability and clinical utility of this construct and consider using alternative WS calculations.

1. Introduction

Weight suppression (WS), the calculated difference between the highest past weight and current weight, is implicated in the development and course of eating disorders (Lowe, 1993). Conceptually, WS is relevant in treatment of eating disorders. Historically, WS has been considered most relevant in the treatment of bulimia nervosa (BN), as many individuals with BN report a history of being overweight (Garner & Fairburn, 1988). Following weight loss, refusal of an individual with BN to return to their initial weight may facilitate patterns of restriction, binge eating, and purging (Butryn, Lowe, Safer, & Agras, 2006). Additionally, as those high in WS may be more likely to gain weight during treatment, these individuals may be at risk for shape and weight concern related to weight gain, influencing treatment efficacy (Lavender et al., 2015). Further, higher levels of WS may be a marker for the use of more extreme weight control behaviors, as individuals who experience initial weight loss may experience biological and metabolic changes that make it difficult to maintain initial losses (Butryn, Jurascio, & Lowe, 2011). Although initially focused on within the context of BN, evidence suggests that WS may have broad relations to eating disorder symptoms across diagnostic categories (Lavender et al., 2015).

WS relates to elements of eating pathology, including dietary restraint, binge eating, purging, and weight gain (Butryn, Juarascio, & Lowe, 2011; Lowe et al., 2006; Lowe, Doshi, et al., 2013a). There is increased evidence that the construct of WS plays an important role in both the development of BN as well as in the maintenance of bulimic symptoms (Butryn et al., 2011; Lowe, Thomas, Safer, & Butryn, 2007). A multisite study of predictors in outcomes in the use of Cognitive Behavioral Therapy for BN indicated that increased WS was a significant predictor of treatment drop out, and, for those who did complete treatment, findings indicated an inability to abstain from purging and binge eating (Butryn et al., 2006).

Although WS predicts eating disorder symptoms and weight gain across both clinical and nonclinical populations (Berner, Shaw, Witt, & Lowe, 2013; Lowe et al., 2006), no investigations have evaluated whether its traditional calculation yields the most parsimonious or clinically-informative measure of weight fluctuation. Some studies indicate that an individual's body mass index (BMI) moderates relations between WS and weight gain, binge eating, purging behaviors (Berner et al., 2013; Butryn et al., 2011), such that among those with higher BMI, higher WS may be particularly predictive of maladaptive outcomes. However, because the construct is based on a change score, the current

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conceptualization of WS does not specifically account for differences in current weight or BMI. For example, the current calculation of WS does not consider whether an individual reports their current or highest past weight in a healthy or unhealthy range; thus, it is not yet known if the degree of WS remains consistently meaningful across various body weight values.

1.1. Issues in the use of weight suppression

In addition to the potential impact of initial body weight on the relation between WS and variables of interest, the current calculation method for WS may present issues related to reliability, interpretation, and clinical utility. WS is a change score, which is a methodological approach that has been criticized for potential poor reliability due to issues such as restricted range, the reliability of difference scores (subtracting one variable from another; typically Time 2 score–Time 1 score of the same variable), and high intercorrelation between the components used to compute the difference score variable (Chronbach & Furby, 1970; Earleywine, 1995; Norman, 1989; Zimmerman & Williams, 1982). Because reliability estimates require a full range of scores, it is possible that any restricted range may attenuate reliability estimates for change scores. As applied to this construct, WS should represent a normal distribution, including those with both high and low levels of the variable, to ensure reliability.

An additional concern related to reliability arises when the construct representing the change score is less reliable than the individual components. A change score may be unreliable if one of its components is also unreliable. For instance, if individuals are not consistent in reports of their highest lifetime weight, this could negatively influence the reliability of the WS variable. With regards to self-reported current weight estimates, existing evidence suggests that short-term reliability of current weight is generally good, with self-report correlating at .96 for weight, and .92 for BMI when asked 2 years apart (Kawada & Suzuki, 2005). Similarly, a correlation of .85 has been reported between measured weights at age 25 and recalled weights at age 25 when recalled 20 years later (Tamakoshi et al., 2003). Therefore, change scores calculated from self-reported weights (both current and historical) may have minor reliability concerns.

Correlation between individual components can also impact change score reliability estimates, such that the reliability of a difference score decreases as the correlation between components increases (Chronbach & Furby, 1970). Noted by Earleywine (1995), change scores can be reliable if they are derived from uncorrelated components. For WS, having uncorrelated components would mean that current weight and the highest past weight would be unrelated; however, this seems unlikely. Therefore, in studies where current weight and past highest weights are highly correlated, it may not be advisable to use the traditional change score to define WS.

Along with reliability issues, another concern includes the law of initial values (Lacey & Lacey, 1962; Wilder, 1931). According to the law of initial values, the degree of change depends on the initial level of that particular variable or function, such that greater change is likely when the initial value of a particular variable is more extreme. In the case of WS, participants with higher initial weights often have a greater potential for larger decreases in weight over time; therefore, change scores alone (traditional WS) may be correlated with the magnitude of the highest weight. In this case, WS may not capture unique variance above an individual's highest lifetime weight.

Finally, in addition to traditional concerns with the use of change scores, weight change may be considered to be a clinically imprecise measurement of health risk across individuals. Consideration of an individual's height may improve upon this measurement, as a certain weight may be clinically concerning (e.g., underweight or overweight) for someone of one height, but may fall in the normal range for someone of a different height. The influence of height differences on weight is most often accounted for through the use of BMI, and one prior study has conceptualized WS in BMI units (Witt et al., 2014).

1.2. Alternative methods for measuring weight suppression

Several authors have proposed alternatives that can address problems associated with change scores (e.g. Chronbach & Furby, 1970; Earleywine, 1995; Edwards, 2001). Below, we present four alternative ways that WS might be calculated: (1) using change in BMI units; (2) evaluating BMI category change; (3) using percent change scores; and (4) implementing two different uses of regression residuals.

The first three approaches for calculating WS attempt to better account for body height as well as the law of initial values (see Lacey and Lacey (1962); Wilder (1931) for further details). First, change in BMI accounts for differences in height, which may remove random variance in WS, as explained above. The second approach, using BMI category change (e.g., moving from overweight to non-overweight weight class), presents a clinically meaningful way to categorize weight difference. Therefore, this approach accounts for the possibility that the WS construct has different implications for individuals of different body weights (i.e., normal weight vs. extreme low or high weight). The third approach also attempts to reduce the possibly arbitrary influence of an individuals' height on weight, using *percent* change scores to assess WS through expressing the difference between the highest and current weight as a function of the individual's highest weight. Therefore, using percent change scores circumvents issues related to the law of initial values (Lacey & Lacey, 1962; Wilder, 1931).

Regression residuals offer a fourth alternative approach to expressing WS. Regression-based approaches to analyzing change across two time points may be particularly relevant when an initial value of an outcome variable could impact the degree of change (Lacey & Lacey, 1962; Fitzmaurice, 2001), and have been used across a variety of outcomes (e.g. cognitive decline, Launer et al., 2011; changes in physical activity levels, Wolin, Glynn, Colditz, Lee, & Kawachi, 2007; weight gain over time, Siega-Riz et al., 2011). Regression residuals have been recommended as an alternative to change scores within other disciplines, such as substance use (Earleywine, 1995). In order to compute regression residuals for WS, an individual's highest weight would be used to predict his or her current weight. The residual (i.e., the difference between predicted weight based on the regression line and observed weight) serves as an index of WS, as it is orthogonal to the participants' highest weights. Therefore, residuals offer researchers more than one way to express change, without the influence of change score components. Within the WS literature, this can account for variance within current or highest weight that is not relevant to weight change.

1.3. The current study

The current study considered four alternative calculations of WS, described above, along with potential benefits or complications associated with each. We provide examples of how each WS calculation method relates to variables relevant to WS within an undergraduate sample, including the highest weight, current weight, height, age, eating pathology. We also examined the relation of different calculations of WS to measures of variables relevant to the etiology of disordered eating. In particular, within various models of disordered eating (e.g., The Transdiagnostic Model of eating disorders; Fairburn, 2008), dietary restraint and social influences such as teasing are considered important etiological factors (Fairburn, 2008; Heatherton, Polivy, & Herman, 1991; Lowe et al., 2007). First, restraint has been theoretically linked with WS, as engaging in dietary restriction is necessary for individuals to reach and maintain a suppressed weight (Wilson, Grilo, & Vitousek, 2007). Furthermore, researchers have hypothesized that reduction in restraint and normalization of eating patterns may induce weight gain for individuals with eating disorders who are also high in WS (Butryn et al., 2006). Second, psychosocial factors such as perceived weight